NATURE OF CARBON PHASES IN ALH84001. E. K. Gibson Jr.[1], C. S. Romanek[2], D. S. McKay[3], K. Thomas-Keprta[4], C. C. Allen[4], and S. Wentworth[4], [1]Mail Code SN4, Planetary Sciences Branch, NASA Johnson Space Center, Houston TX 77058, USA, [2]Savannah River Ecology Laboratory, Drawer E, University of Georgia, Aiken SC 29802, USA, [3] Mail Code SN, NASA Johnson Space Center, Houston TX 77058, USA, [4]Lockheed Martin, Mail Code C-23, NASA Johnson Space Center, Houston TX 77058, USA.

ALH84001, with a 4.5 Ga crystallization age, offers the unique opportunity to study a variety of martian processes involving carbon. This record is recorded on the surface and within the meteorite. Carbonate globules (ranging from 250 to 25 microns in diameter) comprise approximately one percent of the meteorite. None of the other eleven SNC meteorites contain carbonates of similar size or abundance. A high temperature origin for the carbonate globules was proposed by Harvey and McSween [1], despite Romanek et al.'s [2] isotopic data suggesting formation from fluids of 0° to 80°C. Bradley et al. [3] studied magnetites within carbonates of ALH84001 and suggested they formed in fumarole-like conditions at temperatures above 500°C. Oxygen isotopic measurements by Valley et al. [4] on carbonates globules, which have been chemically characterized, showed formation temperatures below 100°C. The identification of shock textures [5] suggests the possibility that remobilization of carbonates along veins and fractures by impact driven processes has taken place.

Grady et al. [6] noted four distinct carbon components present within SNC meteorites: materials that combust at temperatures usually associated with organics (possibly terrestrial contaminants), carbonates, magmatic carbon, and trapped martian atmospheric CO_2. They noted the isotopic compositions of these species were distinct. From the studies of [2] and [6], it is clear that ^{13}C in the carbonates is truly indigenous martian and not a product of the Antarctic environment. Martian carbonates' ^{13}C composition is 40 ± 2‰ and represents a product of interaction of the martian atmosphere with the regolith and fluids. An organic component was identified to have a ^{13}C composition of -21.5‰ [6]. Magmatic carbon (C released above 700°C) has a ^{13}C composition of +0.8‰ [6].

McKay et al. [7] noted the presence of indigenous reduced carbon in the form of polycyclic aromatic hydrocarbons (PAHs) associated with surfaces containing carbonate globules. The PAHs spectra for ALH84001 is unique from those of carbonaceous chondrites, ordinary chondrites, interplanetary dust, typical terrestrial soils or weathering products observed on Antarctic meteorites. Clemett and Zare [8] showed that the Antarctic environment does not contribute PAHs signature to ALH84001 and the model presented by Becker et al. [9] for concentrating PAHs within carbonates does not apply to ALH84001.

Ion microprobe studies by Valley et al. [4] have shown the presence of C enriched in ^{12}C composition within selected regions of the globules. They found small pockets of carbon within the bulk carbonate (^{13}C = +40 ± 2‰) which was 48 ± 2‰ lighter in composition. Flynn et al. [10] noted the irregular distribution of a carbon phase (either graphite or organic C) witin the carbonate globules. The wide range of C isotopic values (range from +40‰ to -30‰) is certainly suggestive of disequilibrium, which may possibly be explained by a biological component. Identification of additional organic components within the meteorite will further clarify the nature of the microstructures in the meteorite.

References: [l] Harvey R. P. and H. P. McSween (1996) *Nature*, *382*, 49-51. [2] Romanek C. S. (1994) *Nature*, *372*, 655-656. [3] Bradley J. P. et al. (1996) *GCA*, *60*, 5149-5155. [4] Valley J. W. et al. (1997) *Science*, *275*, 1633-1638. [5] Scott E. R. D. et al. (1997) *LPSC XXVIII*, 1271-1272. [6] Grady M. M. et al. (1994) *Meteoritics*, *29*, 469. [7] McKay D. S. et al. (1996) *Science*, *273*, 924-930. [8] Clemett S. and Zare R. N. (1997) ACS San Francisco, Abstracts. [9] Becker L. et al. (1997) *GCA*, *61*, 475-481. [10] Flynn G. J. et al. (1997) *LPSC XXVIII*, 365-366.